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This admirable report of progress, covering nearly 300 pages and accompanied by three large-scale maps and dealing with the surface geology of perhaps one-third of New Jersey, establishes a precedent that those in charge of other geological surveys will do well to follow. It will no doubt be a surprise to many who read the topographic history of New Jersey as interpreted by Salisbury, to learn that in the surface features of the land there is preserved a record that is fully as interesting and instructive as the history of past faunas and floras, which for a long time was considered the special field of the geologist.

Geologists and geographers alike will await with interest the appearance of the final monograph of the surface features of New Jersey, which the reports of progress already issued lead them to expect.

ISRAEL C. RUSSELL.

Bulletin of the Geological Society of America. Vol. VI., pp. 103–140; Pl. 1. *Reconstruction of the Antillean Continent.* By J. W. SPENCER, A.M., Ph.D., F.G.S. (L. & A.). January, 1895.

In this paper the author arrives at some very striking conclusions concerning the elevation of the Antillean island during Pliocene and early Pleistocene times. The deep depressions, which cross the continental shelf and which are believed by the author to be drowned valleys, furnish him data by which to estimate the amount of such elevation. Between Cape Hatteras and the Bahama Islands four clearly marked depressions cross the continental plateau. Three of them are in line with rivers of the coastal plain. These fjords can be traced for distances between 200 and 300 miles, and into water 12,000 to 14,000 feet deep. One of them sinks over 5000 feet below the level of the submerged plateau and is comparable to the Grand Cañon of the Colorado. Between the Bahama islands are depressions traceable for distances up to 350 miles, and from depths of about 2000 feet into waters 10,000 to 14,000 feet deep. In the Gulf of Mexico similar submerged valleys exist, and in most cases they are closely related in position to existing rivers. They are traceable into water 10,000 feet deep. Their bottoms sink from 800 to 3000 feet below the top of the valley sides, and they are several miles in width. Other fjords occur off the coasts of the West Indies, and around the Caribbean Sea, some of which are traceable into depths of 12,000 feet.

The author concludes that these are land valleys which have been greatly depressed. He bases his conclusions, (1) upon their general resemblance in contour to land valleys, and (2) upon their direct connection (in most cases) with existing rivers, save where such connection has been manifestly obliterated or obscured by recent coastal deposits. In many respects these depressions resemble land valleys, and the author's conclusion has a strong basis of probability. The following consideration may, however, be urged against his view. If these depressions are drowned land valleys, the soundings ought to show the existence of great deltas at their mouths. The author makes no mention of such deltas and the inference is that they do not exist. Their absence, so far as known, is a serious objection to the author's view.

The logical inference from Mr. Spencer's conclusion respecting these fjords is that the land formerly had a much greater elevation than at present. Assuming that the depth to which the mouths of the fjords are now submerged is nearly the exact measure of the former elevation of the continent, and making a small allowance for foldings and amplified marginal depressions, Mr. Spencer concludes that this elevation was not less than 8000 feet along the northern shore of the Gulf of Mexico, about 12,000 feet in the vicinity of Yucatan, 10,000 or 12,000 feet for the Greater Antilles and nearly the same for the southeastern margin of the continent. The soundness of this assumption will be considered later. Waiving for the moment this point, let us note the author's conclusions.

In the West Indies Mr. Spencer has found two series of deposits which he correlates with the Lafayette formation and with the older Columbia series. To these he gives the names Matanzas and Zapeta, respectively. They are separated from each other by strongly marked unconformities. The Matanzas is likewise separated from the upturned and deeply eroded Miocene beds by a great unconformity. Combining the data furnished by these deposits with the quantitative element furnished by the fjords, the author reaches the following conclusions as to the oscillations of the land. From an elevation toward the close of the Miocene much lower than at present, the land in the Pliocene was elevated according to location from 8000 to 12,000 feet higher than at present. The close of the Pliocene saw the Antilles and the neighboring parts of the main land 100 to 1100 feet lower than at present. During this depression the Matanzas limestone was formed. This subsidence was followed by a re-elevation in early Pleistocene times, probably as great as that of the Pliocene. The fjords crossing the continental shelf were first excavated during the Pliocene, and then re-excavated — so far as filled during the Matanzas depression,—and deepened during the Pleistocene elevation. Later in the Pleistocene the land sank to a level 25 to 500 or 700 feet below the present elevation and the Zapeta loams and gravels were formed. Minor oscillations, not yet well worked out, have since taken place.

The most important conclusion of this paper, *i. e.*, the amount of the elevations, is based upon the assumption that the continent stood as much above sea level as the fjord bottoms are below it, less some correction for unequal subsidence of the continental area. Although granting that a correction should be made for unequal subsidence, the author seems, so far as appears from his paper, to have practically neglected this point in his calculation of the former elevation of the land. The amounts of elevation which he gives for the various regions are almost as much as the amounts by which the fjord bottoms lie beneath the sea level. It seems possible to account for the depths to which the mouths of the fjords are submerged, without assuming that the continent stood at such heights.

Grant that the elevation was sufficient to permit streams to cut valleys across the continental shelf hundreds of feet deep, and in one instance, at least, to excavate a cañon comparable to the Grand Cañon. It is probable that subsidence, once started, would be greater along the edge of the continental shelf than further inland. This would naturally follow on the doctrine of isostasy from the loading of the outer part of the continental shelf by sediments, deposited as the shore line advanced inward. It seems highly probable that the subsidence would be of the nature of a seaward tilting of the land and a deepening of the ocean basins.

Such differential motion along lines normal to the coast would increase the gradient of the bottoms of these buried channels. Before the author's hypothesis of practically uniform subsidence along normals to the coast can be accepted, it is incumbent upon him to show that the above hypothesis of subsidence with great tilting is inapplicable to the case in hand. So far as known to geologists, all epeirogenic movements are in the nature of tiltings and warpings rather than rigid uniform changes. If the subsidence were uniform or varied only along lines roughly parallel to the coast, the buried channels would retain practically the same gradient as they had when land valleys. A rough means of testing this hypothesis is thus at hand.

If the gradient of the fjords is much greater than that of land valleys, which most closely correspond to them in width and depth, the conclusion that the land "stood as high as the fjords are deep" would seem not to be warranted. Moreover, if the subsidence along normals to the coast was equal, the gradients of the bottoms of the fjords would be less than the gradients of the rock bottoms of the rivers, of which the fjords are continuations. For the gradient of a valley is always greater nearer its head than in its lower part, if the rocks are not greatly different in the two pàrts of the course. Further, the rivers of the coastal plain meander in wide valleys, now filled to a considerable depth with alluvial deposits. The width of these valleys compared to their depth, where known, shows that they were well advanced in the cycle of erosion, and that their gradients must have been comparatively low. If this be true for the valleys of the coastal plain, to a much greater degree must it be true for the submerged parts of these valleys across the continental shelf. From what is known of the dimensions and contours of these fjords, a low gradient can be confidently predicted, unless the continental shelf has been tilted seaward.

From the data given, the gradient of a few of these fjords can be estimated. The Bahaman valley has an average fall of twenty-four feet per mile for 350 miles; the Floridian, of twenty-five feet per mile for 400 miles; the Cazones, of seventy feet per mile for seventy-five miles, and the Altamahan, of nineteen feet per mile for 300 miles. These gradients are much greater than those of corresponding land valleys. The Grand Cañon of the Colorado has an average fall of less than eight feet per mile for 284 miles.[1] Judging from borings in the alluvium deposits of the Mississippi at New Orleans and Memphis, the rock bottom of the river between these two points has a gradient of but little more than two feet per mile. Since it is not certain that these borings reached the deepest part of the valley at their respective localities, the gradient may be more than this; it may, however, be less. But in spite of this element of doubt it is absolutely certain that the gradient is much less than that of the submerged valleys. The gradient of the fjords, considered in respect to the size of these valleys and compared with the low gradient of land valleys strongly favors the hypothesis that the subsidence was much greater remote from the present coasts, than it was along the shore. It cannot, therefore, be safely concluded that because the mouths of these fjords are now submerged to depths from 10,000 to

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[1] DUTTON: United States Geological Survey, Monograph II., p. 240.

12,000 feet or more, that the whole Antillean continent stood an equal amount above its present level.

The bottom of the fjords, particularly the landward portion, have probably been somewhat filled with sediments. The gradients as calculated from the soundings may be too great. But it is not probable that the possible error from this cause can bridge the discrepancy between gradients of the fjords and those of similar land valleys. The facts given by Mr. Spencer prove a greater elevation of the continent in Pliocene and in early Pleistocene times than at present, and a lower level at the end of the Pliocene and later in the Pleistocene. It may be fairly questioned, however, whether they prove the great elevation above the present level which is claimed.

HENRY B. KÜMMEL.

Elements de Paléontologie. By FELIX BERNARD, Paris, 1895; 1146 pages, 606 illustrations, Baillaire & Son.

A new palæontology bringing up to recent date the more important results of work in this field will be welcome to many. It includes a phytological as well as zoölogical portion, though the *Invertebrata* are more fully treated than the remainder. Morphology and classification are treated with especial fullness, though the latter is carried down only as far as the family or, usually, the genus. The phylogeny and embryology of groups is also given in summary at the close of the different sections. The sections on the brachiopods and the crinoids are especially well developed, and the introductory chapter of the book in which the scope of palæontology and its relations to other sciences is discussed will be found of especial interest.

E. C. QUEREAU.